Original Article

Measurement Invariance Analysis of the Parental Stress Index

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Abstract: While parenting research continues to compare similarities and differences in mothers' and fathers' behaviors based on mean values on the respective dimensions, measurement invariance as a prerequisite for these comparisons has seldom been assured. The present study thus subjected the well-known Parenting Stress Index (PSI), widely used in models of family functioning, to a rigorous measurement invariance analysis based on (N = 214) Austrian couples with children younger than 3 years of age. We evaluated configural, metric, scalar, and uniqueness invariance on item and subscale levels, and tested for structural invariance of means and variances of the PSI parent and child domain by second-order confirmatory factor analyses. As a result, only measurement differences on the scalar levels affected the factor scores, though negligibly. On the structural levels, no differences were found on the PSI child domain across parents, but on the PSI parent domain, mothers reported more stress.

Keywords: measurement invariance, father-mother distinction, parental stress

Parental stress is one of the key constructs in models of parent behaviors and family functioning (e.g., Abidin, 1992; Deater-Deckard, 1998), which has been associated with children's negativity and behavioral adversity (Tharner et al., 2012). Parental stress has also proven to diminish the ability to adapt parenting to children's needs (Paulussen-Hoogeboom, Stams, Hermanns, & Peetsma, 2008), and to cause an authoritarian rather than authoritative parenting style (Deater-Deckard & Scarr, 1996), which in turn might impair good parent-child relationships. Thus, numerous empirical studies linked elevated parental stress to less secure parent-child attachment (e.g., Diener, Nievar, & Wright, 2003) and bad parenting beliefs (Respler-Herman, Mowder, Yasik, & Shamah, 2012).

The most frequently used measure of parental stress in those studies is Abidin's *Parenting Stress Index* (PSI; Abidin, 1983) by which researchers repeatedly reported higher stress levels in mothers than in fathers, specifically on the PSI subscales *Role Restriction*, *Isolation*, and *Spouse* (Hildingsson & Thomas, 2014; Widarsson et al., 2013). However, it remains unsolved whether the perceived results on parents and parenting are really comparable for mothers and fathers and thus justify to speak about differences on those scales (Day & Mackey, 1989).

Searching through family research, remarkably few equivalence analyses across parents exist (see Adamsons & Buehler, 2007; Fagan, Day, Lamb, & Cabrera, 2014). Some studies indicated equivalence between parents (e.g., Finley, Mira, & Schwartz, 2008; Prinzie, Onghena, & Hellinckx, 2007; Van Leeuwen & Vermulst, 2004), and other studies found more differences than similarities across the parents (e.g., Adamsons & Buehler, 2007; Corwyn & Bradley, 2005; Whiteside-Mansell, Bradley, & Rakow, 2001). For example, when mothers and fathers reported on children's behavioral problems and temperament they normally agree only moderately (Grietens et al., 2004) even though measurement invariance on these scales seemed to hold (Chiorri, Hall, Casely-Hayford, & Malmberg, 2016; Clark et al., 2016). Likewise, scores of perceived global stress confirmed equivalence across the gender of the parents (Lavoie & Douglas, 2012; Taylor, 2015) whereas reported stress reactions scored higher in women than in men (Schlotz, Yim, Zoccola, Jansen, & Schulz, 2011). Unfortunately, specific parental stress reactions were explored only by one measurement invariance analysis (Deater-Deckard & Scarr, 1996) in which only the PSI short form was tested (Abidin, 1995). As several items were excluded metric invariance of the PSI was evaluated only for 17 out of 36 items, so it remains problematic to generalize this result to the complete construct of parental stress as assessed by PSI. Moreover, without scalar measurement invariance, it is questionable whether mean differences between mothers and fathers reflect true differences of the respective latent variable.

The present study therefore aims to evaluate the full version of the PSI measurement in terms of its invariance

across the parents. Using confirmatory factor analyses, we assess all applicable levels of measurement invariance, gaining insights into qualitative equivalence, biases, levels of noise, mean levels, and spread (see Vandenberg & Lance, 2000).

Methods

Participants

The sample was recruited in Lower Austria and Vienna as part of the CENOF Research Study (see Ahnert, Supper, & CENOF, 2014). The present study involved $N = 214$ couples with young children (52% female). Ages of the target children ranged from 12 to 32 months with $m = 19.1$ ($SD = 4.9$) months. Mothers were on average 34.0 ($SD = 5.3$) and fathers 36.3 ($SD = 7.0$) years old. All couples were either married (63.4%) or lived in a solid partnership. The sample represented typical Austrian middle to upper class with 42.7% of both parents holding a master degree and above. In 17.9% of the families only the father and in 20.6% only the mother had finished university. All but three fathers were in paid work ($m = 41.5$ hr/week, $SD = 10.3$), in contrast to only 53.2% of the mothers, who worked on average 18.6 hr/week ($SD = 9.4$). The mean household size was 3.6 ($SD = 0.8$) persons on average. Each household was visited twice. During the visits, mothers and fathers filled out the questionnaires of the PSI on different days and in randomly assigned orders. All participants gave signed informed consent.

Measures

Parental Stress

Parental stress was assessed using the German version of the Parenting Stress Index (Tröster, 2011), which contained some minor differences to the PSI 3rd edition (Abidin, 1995). In the German version, items were removed due to practical and theoretical considerations, finally keeping 48 of the 101 original items. Reasons for removal were, for example, cultural adequacy like not using "being happy with the last purchase of clothing for oneself" as an indicator of depression, and items which failed the commensurateness for fathers and mothers of older children, for example, "concerns with the time in hospital immediately after giving birth." However, the original structure in terms of a *child* and a *parent domain* – each including several subscales with four items each – was preserved. The parent domain comprises the original subscales: (a) C*ompetence* capturing lack in practical knowledge and management skills of parenting, (b) *Isolation* measuring social isolation due to child rearing responsibilities, (c) *Attachment* assessing inability to observe and understand the child's feelings and needs accurately, (d) *Health* capturing deterioration in health as a result of parenting, (e) *Role Restriction* reflecting restrictions in maintaining former freedom and identity, (f) *Depression* relating to guilt and unhappy feelings, and (g) *Spouse* describing lack of emotional and active support of the other parent. The child domain consists of the subscales: (h) *Distractibility/Hyperactivity* depicting behavioral symptoms of the child, like restlessness and short attention span, (i) *Adaptability* assessing the child's inability to adjust to environmental changes, (j) *Demandingness* describing child's tendency to insist, (k) *Mood* capturing the child's negative emotions, and (l) *Acceptability* as a measure of how troubled the parent is with the child not meeting his or her expectations, but omits the original subscale *Reinforces Parent*. In contrast to the original PSI, which utilizes multiple response formats, all 48 items were scored on a consistent 5-point Likert scale, ranging from 1 = *strongly disagree* to 5 = *strongly agree* with Cronbach's α ranging between .68 and .77 for all subscales of the child domain and between .61 and .83 for all subscales of the parent domain (according to the German manual). Cronbach's α for the whole child domain is .91 and .93 for the parent domain.

Data Analysis

All confirmatory factor analyses were conducted with MPlus 7.1 (Muthén & Muthén, 1998–2012) leading to two models for the child and parent domain for each parent, which were later compared across the parents.

Base Model

With respect to the distinct nature of the child and parent domain, we modeled both domains separately, but proceeded with them in an analogous fashion. To preserve the domain-subscale-item hierarchy, we translated all data to a second-order confirmatory factor analyses, using the domains as second-order factors, the subscales as first-order factors, and the items as manifest indicators. Data of both parents were modeled simultaneously with correlated errors for the same items across parents. Those correlations were necessary to avoid estimation errors due to non-consideration of data dependence (Card, Selig, & Little, 2008). The resulting configural invariance models served as a base for consequent analyses (see Figure 1 for the model scheme).

Model Estimation

For model estimation, we treated item responses as ordered categories (see Elosua, 2011) and used the robust weighted least squares algorithm (WLSMV; Muthén, du Toit, &

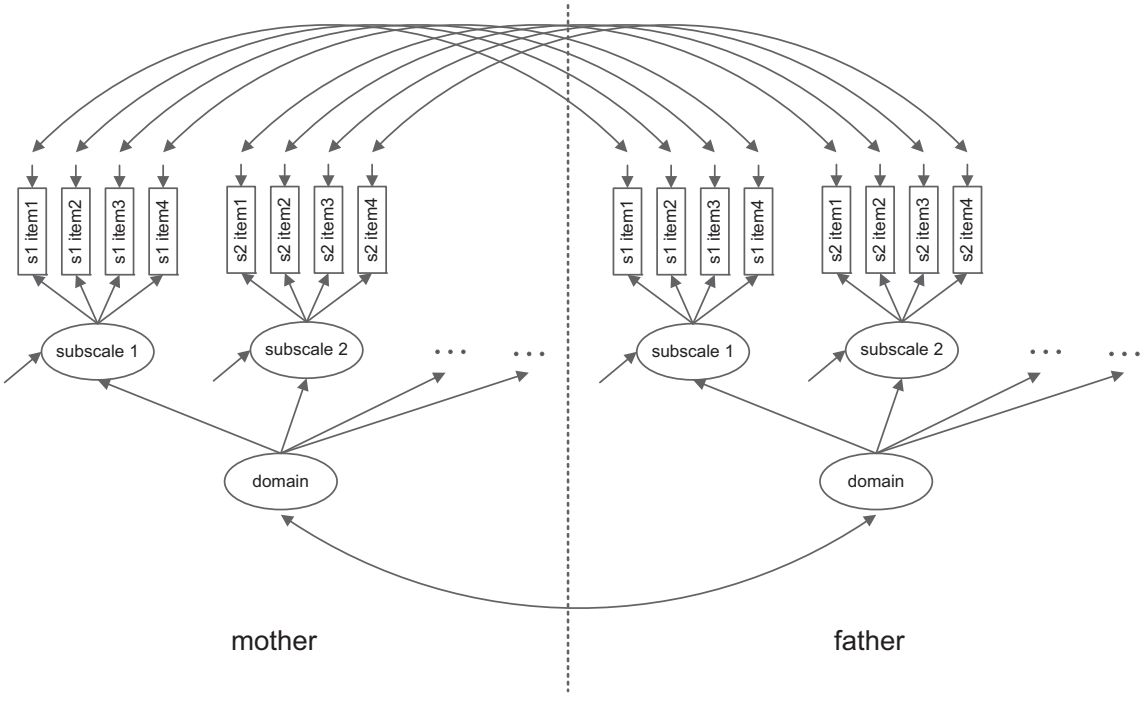

Figure 1. Schema of the PSI domain base model.

Spisic, 1997) because category distributions appeared asymmetric and the category number was as low as three for some items. WLSMV performed well under these conditions (Savalei & Rhemtulla, 2013).

Model Comparison

After controlling for adequate fit of the configural invariance model (CFI $\geq$ .90 and RMSEA $\leq$ .08) we aimed to test higher levels of invariance. Those tests consisted of stepwise fixation of parameter classes across parents (see Millsap & Yun-Tein, 2004). The change in model fit was evaluated with chi-square difference tests using the MPlus function *DIFFTEST*. To minimize type I errors, we set the statistical significance level conservatively at $p < .01$.

Assessed Levels of Invariance

In the sequence of model constraints, we deviated slightly from the usual course for second-order multigroup factor invariance analysis (Chen, Sousa, & West, 2005). Because item thresholds in the categorical case cannot be as easily disjoined from the corresponding factor loadings as item intercepts in linear models, we kept them together. Instead of alternating between items and subscales for each invariance level, all levels of invariance at the item level were evaluated before we moved to the subscales. The analyses sequence was metric, scalar, and lastly uniqueness invariance for the item levels, followed by the same sequence for the subscale levels. Finally, the structural parameters, mean and variance of the domains were tested for invariance. Confronted with significant differences on any level, we eventually aimed to achieve partial invariance by removing the most problematic parameter constrain until the fit difference vanished (see Dimitrov, 2010). Thereby, we were able to identify gender differences of parental stress in detail.

Results

The Child Domain

The configural invariance model of the child domain fitted the data acceptably without any further adjustments (see Table 1). Within the consecutive models, we encountered invariances only when testing scalar invariance on item level (see Table 2). Furthermore, differences were small and partial invariance was attainable. For *Distractibility/Hyperactivity* item 1: *My child is more active than most other children*, fathers' first two thresholds were lower than those of the mothers. In other words, given the same true latent value on this subscale, fathers were less prone to disagree than mothers. In contrast, fathers had higher thresholds on *Demandingness* item 1: *Some behaviors of my child (linger,*

Table 1. Tests of measurement equivalence of the PSI child domain

	Model fit				Difference test[1]		
Model	*df*	χ^2	RMSEA	CFI	vs.	Δ*df*	$\Delta\chi^2$
Measurements at item level							
1. Configural invariance	709	1,071.5*	.049	.920	–	–	–
2. Metric invariance	724	1,046.5*	.046	.928	1	15	12.7
3. Scalar invariance	796	1,145.1*	.045	.923	2	72	142.0*
3a. Partial scalar invariance[2]	791	1,120.9*	.044	.927	2	67	93.5
4x. Residual variance free	771	1,128.8*	.047	.921	–	–	–
4. Uniqueness invariance[3]	791	1,120.9*	.044	.927	4x	20	15.3
Measurements at subscale level							
5. Metric invariance	795	1,109.7*	.043	.930	4	4	1.8
6. Scalar invariance	799	1,115.7*	.043	.930	5	4	9.2
7. Uniqueness invariance	804	1,116.5*	.043	.931	6	5	3.9
Structural parameters							
8. Invariance of domain mean	805	1,118.9*	.043	.930	7	1	2.4
9. Invariance of domain variance	806	1,126.6*	.043	.929	8	1	4.6

Notes. [1]Due to the WLMSV estimation a corrected $\Delta\chi^2$ was computed by the MPlus function DIFFTEST. [2]Thresholds #2–4 of demandingness item 1 and thresholds #1, 2 of distractibility/hyperactivity item 1 were freed. [3]Equal to model 3a, but nested in and compared to a different model (4x not 2). *$p < .01$.

Table 2. Non-equivalent parameters (standardized) across mothers and fathers within the PSI child domain

	Mothers		Fathers	
Parameter	Estimate	*SE*	Estimate	*SE*
Item thresholds				
Demandingness item 1 #2	−1.03	0.13	−0.30	0.11
Demandingness item 1 #3	−0.59	0.11	0.13	0.11
Demandingness item 1 #4	0.95	0.12	1.74	0.17
Distractibility/Hyperactivity item 1 #1	−1.36	0.14	−1.90	0.18
Distractibility/Hyperactivity item 1 #2	−0.27	0.10	−0.95	0.12

whine, disobey, object) cost me a lot of energy. Hence, fathers reported less agreement than mothers with the same true latent value on the subscale *Demandingness*. No further significant measurement differences were found, and mean and variance of the child domain proved to be equivalent as well. All input data as well as the results of all analysis steps are provided in Electronic Supplementary Materials, ESM 1.

The Parent Domain

The configural invariance model of the parent domain fitted the data acceptably without any further adjustments (see Table 3). Although partial equivalence was found for all higher levels of measurement invariance, there were some differences regarding location parameters between mothers and fathers (see Table 4). On the item level *Attachment* item 4: *It takes a long time for parents to develop close, warm feelings for their children*, *Isolation* item 4: *I often feel left alone to myself*, and *Spouse* item 2: *Since having my last child, I have had less interest in sex* had higher thresholds for fathers than for mothers. Therefore, fathers' agreements to these items were comparatively lower than mothers' based on equal true latent values on the respective subscales.

On the subscale level, the location biases were more heterogeneous. While the paternal intercept of the subscale *Depression* was lower than the maternal one, the opposite was true for the subscales *Isolation* and *Attachment*. As a result, less stress was reported by fathers on the *Depression* subscale, whereas mothers displayed less stress on the *Isolation* and *Attachment* subscales. On the structural level, we found that fathers stated less stress within the parent domain in general, taking all measurement biases into account. For the results of all analysis steps see ESM 1.

Table 3. Tests of measurement equivalence of the PSI parent domain

	Model fit				Difference test[1]		
Model	*df*	χ^2	RMSEA	CFI	vs.	Δ*df*	$\Delta\chi^2$
Measurements at item level							
1. Configural invariance	1,441	1,755.1*	.032	.943	–	–	–
2. Metric invariance	1,462	1,777.4*	.032	.943	1	21	34.4
3. Scalar invariance	1,565	1,970.0*	.035	.930	2	103	374.1*
3a. Partial scalar invariance[2]	1,556	1,879.8*	.031	.941	2	94	127.2
4x. Residual variance free	1,528	1,856.7*	.032	.941	–	–	–
4. Uniqueness invariance[3]	1,556	1,879.8*	.031	.941	4x	28	37.5
Measurements at subscale level							
5. Metric invariance	1,562	1,878.9*	.031	.943	4	6	8.4
6. Scalar invariance	1,568	1,949.5*	.034	.931	5	6	84.6*
6a. Partial scalar invariance[4]	1,565	1,883.9*	.031	.942	5	3	7.5
7. Uniqueness invariance	1,572	1,888.0*	.031	.943	6a	7	8.9
Structural parameters							
8. Invariance of domain mean	1,573	1,931.8*	.033	.935	7	1	18.2*
9. Invariance of domain variance	1,573	1,858.7*	.029	.948	7	1	1.2

Notes. [1]Due to the WLMSV estimation the corrected $\Delta\chi^2$ was computed by the MPlus function DIFFTEST. [2]Thresholds #1–3 of isolation item 4 and spouse item 2 and thresholds #2–4 of attachment item 4 were freed. [3]Equal to model 3a, but nested in and compared to a different model (4x not 2). [4]Intercepts of isolation, depression and attachment were freed.

Table 4. Non-equivalent parameters (standardized) across mothers and fathers within the PSI parent domain

	Mothers		Fathers	
Parameter	Estimate	*SE*	Estimate	*SE*
Item thresholds				
Attachment item 4 #2	0.52	0.11	1.05	0.13
Attachment t item 4 #3	0.96	0.12	1.64	0.16
Attachment item 4 #4	1.70	0.16	2.46	0.28
Isolation item 4 #1	−0.71	0.13	0.50	0.16
Isolation item 4 #2	0.25	0.12	1.70	0.20
Isolation item 4 #3	0.68	0.12	2.08	0.21
Spouse item 2 #1	−0.97	0.11	−0.42	0.10
Spouse item 2 #2	−0.29	0.12	0.55	0.11
Spouse item 2 #3	−0.04	0.10	0.89	0.13
Subscale intercepts[1]				
Attachment	0	0	0.31	0.11
Depression	0	0	−0.39	0.11
Isolation	0	0	0.71	0.11
Structural parameters[1]				
Latent domain mean	0	0	−0.36	0.08

Note. [1]Due to model identification, parameter is only estimated freely for fathers.

Impact of Bias on Differential Test Functioning

As metric invariance on item and subscale level held true, the PSI assesses qualitatively equal constructs in mothers and fathers. Above and beyond, the reliability was equal for both parents, because uniqueness and factor variance were invariant as well. Nonetheless, violations of scalar invariance were found in both domains, which make direct comparisons of score levels across the domains unfeasible. Notably, full measurement invariance models, which do not account for biases, would still adequately fit the data (child

domain: CFI = .924, RMSEA = .044; parent domain: CFI = .930, RMSEA = .034). To assess the magnitude of differential test functioning considering the complex data structure, that is, hierarchical and interdependence across groups, we simply compared the factor scores of the final partial invariant models with those of their fully invariant counterparts.

In the child domain, the resulting factor scores of both models were a close match. The rank order was very similar with a maximal shift of two ranks and a mean shift of 0.24 ranks for fathers and 0.26 for mothers. Between the parents, differences were pooled in fathers' factor scores because mothers' latent domain mean was fixed to zero for model identification. The paternal scores resulting from the partial invariant model were small with m = 0.022 *SD* (*SD* = 0.008), but consistently larger than their full invariant counterparts. Using the R package *BayesFactor* (Morey & Rouder, 2015), we compared the Bayesian hypothesis that the modulus of the difference is not greater than 0.05 *SD* with its counterpart to test whether the difference has any practical relevance. Therefore, we used the Bayesian alternative to significance tests, the Bayes factor, which depicts the ratio of the likelihood probability of the two competing hypotheses. The doubled logarithm of the resulting Bayes factor was 502.1 surpassing by far the threshold for very strong evidence (> 10) as suggested by Kass and Raftery (1995). This is a decisive support for no larger shift than 0.05 *SD* caused by bias within the child domain. For details of the analysis see ESM 1.

In the parent domain, the results were quite similar. Rank shifts were small with m = 0.39 (*SD* = 0.66) and a maximum of five ranks for fathers, and m = 0.55 (*SD* = 0.81) and a maximum of four ranks for mothers. The scores resulting from the partial invariant model were consistently larger than their full invariant counterparts with m = 0.031 *SD* (*SD* = 0.010). The doubled logarithm of the Bayes factor for the hypothesis of a difference not larger than 0.05 *SD* was 298.9. Again, this clearly exceeded the threshold for very strong evidence (> 10), lending firm indication that the mean parent domain scores bias is smaller than 0.05 *SD*s. For details of the analysis see ESM 2.

Discussion

Despite unabated scientific interest in the commonalities and differences in parenting between mothers and fathers, measurement invariance as a prerequisite for such comparisons is very rarely examined. This is true for investigations of parental stress as well, even though comparative parental behaviors are reported in many applied areas, for example, in forensic assessments for child custody (Abidin, Austin, & Flens, 2013) where unbiased results are especially important.

The present study assessed measurement invariance of the German PSI, which captures a broad spectrum of stress for both parents. Results indicated partial measurement invariance for both the child and parent domain. Differences solely occurred in scalar invariance, while metric and uniqueness invariance held true. Hence, qualitatively, the same constructs with equal reliabilities were assessed for mothers and fathers, but a bias of the score levels was found. The bias was located on two items in the child domain pointing toward behavioral maladjustment of the child, whereas three items and three subscales in the parent domain revealed differences among the emotional aspects of parenthood.

Compensating for these biases, we compared mean and variance of the two latent domains across the parents. While no differences were found in the child domain, mothers had a higher mean score than fathers on the parent domain. This result supports previous work (e.g., Hildingsson & Thomas, 2014; Widarsson et al., 2013) which demonstrated a general parental appraisal to difficult child characteristics, but revealed more stress of being a parent for mothers than fathers. The scope of parental stress, however, differed for neither domain as indicated by equal variances across the parents.

As only few biases were found and full invariant models fitted the data acceptably as well, we assessed the magnitude of different functioning of the domain scores. The results for child and parent domain were similar and the biases seemed to mostly cancel each other out (see Bao, Dayton, & Hendrickson, 2009). Changes in the rank order of scores within the domains were negligible and score differences on the domain levels didn't exceed 0.05 *SD*. The magnitude of these differences appeared insignificant on a practical level, and comparisons of both domains between mothers and fathers were applicable in most scenarios.

Despite the overall cancelation of biases, meaningful differences between mothers and fathers existed on a more granular level. For example, fathers reported more stress due to social isolation, which is consistent with research on men in general (Wellman & Frank, 2000) and particularly with fathers (Patulny, 2012) who might be integrated in smaller social networks, receiving less social support than mothers. Mothers described more stress in form of depression, on the other hand, which matches the known high incidence rate of clinical depression in women (Piccinelli & Wilkinson, 2000) and in mothers in particular (Davé, Petersen, Sherr, & Nazareth, 2010). The bias against fathers on the attachment subscale leads to current debate on closeness in fatherhood (see Ahnert et al., 2014), but more research is warranted.

Results, however, are limited as they are based on a quite homogeneous sample from preliminary middle to upper class. Thus, future research must focus on measurement invariance for parents with low income, from ethnic minorities, and being underaged or separated. Because measurement invariance is not an intrinsic property of a measurement instrument, but rather an indicator of potentially different characteristics of the measurement respondents, detailed analyses might help the debate on parenting by revealing if, when and how mothers and fathers are discriminant from each other.

On a practical level the PSI domain scores seem comparable for fathers versus mothers, while some subscales alone are more problematic. Further, we need to keep in mind that mothers generally report more stress on the PSI parent domain, and equal scores still might impact mothers' and fathers' lives differently.

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Electronic Supplementary Materials

The electronic supplementary material is available with the online version of the article at https://doi.org/10.1027/1015-5759/a000463

ESM 1. Data, Text (.pdf)
Measurement invariance analysis of the PSI parent domain (German version).
ESM 2. Data, Text (.pdf)
Measurement invariance analysis of the PSI child domain (German version).

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